or perhaps the instructions called for "harden at a bright red and temper to a straw colour." It was an art guarded with much secrecy and confined chiefly to makers of tools. Pyrometers, structural changes, and a knowledge of the thermal equilibrium diagram of the steel in question were not even thought of. To-day it may be said without exaggeration that modern engineering practice at its best would be impossible were it not based largely upon an art which requires for its performance scientific knowledge, skill, and judgment of a very high order. With the exception of steels very low in carbon, there is scarcely one—certainly no alloy steel—which does not require a precisely defined heat treatment, depending upon the purpose to which it is to be put, if the best value is to be got out of it. Of this the steels used in the automobile industry furnish a conspicuous illustration. The frame, the front and rear axles, the steering parts, springs, crank-shafts, and gears, all have a more or less severe duty to perform and require steels possessing particular qualities of strength, toughness, resilience, endurance, shock resistance, and good wearing properties, which are obtained by suitable heat treatment.

Mr. Bullens has written a very serviceable book on the above subject, of which the first edition was quickly exhausted. The second edition, which we have before us, is a reprint of the first, with an appendix on the heat treatment of modern high-speed tool steels. The opening chapters deal with the testing and structure of steels, and the operations of annealing, hardening, tempering, and toughening. Then follow two on case-carburising and case-hardening, which are exceedingly good. The author has evidently studied Giolitti's researches with great profit to himself and turned the knowledge gained to practical account. An interesting illustration of cast-iron "growth" is furnished by his statement that this is an unsuitable material for case-carburising boxes, whereas malleable iron, soft steel, and wrought iron can all be used. The next two chapters, on the generation and application of heat, are also very valuable, and show the author's practical acquaintance with furnace design, construction, and operation.

The remainder of the book deals with the particular heat treatments in vogue for carbon and alloy steels. Among the latter, nickel, chromium, and nickel-chromium steels occupy an important place. Indeed, nickel steels were the pioneers among the alloy steels. Nickel was originally added merely to give increased strength and toughness over that obtained in ordinary rolled structural steel. When heat treatments were also applied they were found to enhance the valuable qualities of the alloys to such an extent that they soon came to hold, and still maintain, the premier position in alloy-steel metallurgy. The concluding chapters deal with vanadium, manganese, and silicon steels, and various types of tool steel.

The book is one to be warmly commended; it is well written and, on the whole, very accurate in its statements.

H. C. H. C.

SCHOOL AND PERSONAL HYGIENE.

(1) *Crowley's Hygiene of School Life.* By Dr. C. W. Hutt. Pp. xv+428. (London: Methuen and Co., Ltd.) Price 3*s*. 6*d*. net.

(2) *Syllabus of Personal Hygiene for Colleges.* By Prof. E. C. Howe. Third revision. Pp. 207. (Wellesley, Mass.: The Author.)

(1) DR. CROWLEY having accepted an appointment in the Medical Department of the Board of Education, the preparation of a second edition of his "Hygiene of School Life" has devolved upon Dr. Hutt, who has altered, extended, and rewritten where necessary much of the original work. Dr. Hutt has had the task of selecting from a vast amount of material to be found in official reports; this he has performed with good judgment, and his conclusions are sound and convincing.

The position taken in the book is that of the administrator who is limited by the various enactments dealing with the medical and hygienic problems concerned with education, and such subjects, therefore, as over-pressure, the curriculum, and the physiology of writing and of reading have, perforce, to be omitted. The contents include, in order, the physical condition of the child, classification and groups of school children, the infant and infants' schools, medical treatment of school children, the provision of school meals, baths, games and exercises, open-air education, the school and infectious diseases, and the school building. The book is illustrated with some plates and a number of diagrams and plans, and the price is exceedingly moderate.

From the point of view of the administrator who has to deal with things as they are, we do not think that the student of school hygiene can select a better guide than this second edition of Crowley's "Hygiene of School Life."

(2) Prof. Eugene Howe, of Wellesley College, Mass., gives in this book a syllabus of a course of personal hygiene suitable for the students of a general educational institution. The course is divided into thirty lectures. An abstract of each lecture is given, and the right-hand pages are left blank for notes by the student. At the end of the book a bibliography is added, under the various subjects dealt with, of works and papers suitable for further study. The subjects seem to be well chosen and the treatment of them satisfactory. While presumably intended for Prof. Howe's own students, those who may have to give courses of lectures in personal hygiene to lay audiences will find this book a suggestive and useful guide.

OUR BOOKSHELF.

The Elementary Principles of Wireless Telegraphy. By R. D. Bangay. Part ii. Second edition. Pp. viii+241. (London: The Wireless Press, Ltd., 1917.) Price 2*s*.

THE aim of this work is to explain the theory and practice of wireless telegraphy to persons who do

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not possess much knowledge of the theory of electricity. There is no attempt to give purely electrical explanations of the principles involved; instead, the author has made free use of a few well-chosen mechanical analogies, which are worked out in considerable detail.

The discussion of these mechanical vibration problems, with the help of torque-time and velocity-time curves, is a most attractive feature, of the greatest interest to students of physics and engineering.

Part ii. deals mainly with transmitting apparatus and develops the theories of the dynamo, transformer, coupled circuits, spark transmitters, and oscillation valves.

The treatment of these, though necessarily brief, is on the whole remarkably clear and accurate, and is illustrated by a large number of diagrams.

The section, about fifty pages, devoted to oscillation valves is very good indeed. These sensitive contrivances have almost revolutionised the art of wireless telegraphy during the past few years. Unfortunately, there is very little quantitative information given about them; a few more numbers would have been most welcome.

Scarcity of numerical illustrations is perhaps the chief defect of the book; the size of a piece of apparatus and the numerical values of its constants are rarely given. But this is not very serious, and we can warmly recommend the work as a trustworthy and stimulating introduction to the more elaborate treatises on radiotelegraphy.

Field and Laboratory Studies of Crops: An Elementary Manual for Students of Agriculture. By Prof. A. G. McCall. Pp. viii + 133. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 3*s.* 6*d.* net.

THE object of this little book is to provide students of school age with practical exercises in the study of plant life. It is, as it were, a twentieth-century edition of the book of "Common Things" which bored the children of earlier generations. Unlike those forbidding compendiums, it seeks to lead children to a study of Nature through the avenue of experiment, and hence possesses a marked superiority over its early prototypes. Nevertheless, it has the fundamental defect of all those books which seek to evade the disciplinary grind which is the only passport into the world of science. Thus the student is supposed to learn how plants grow by marking corn roots with thread or waterproof ink, and he is advised to draw an entirely erroneous conclusion, namely, that sunlight is necessary for plant growth from an experiment in growing plants in the dark. Having performed the experiment, he is *told* about carbohydrates and is *told* about photosynthesis, on which things and phenomena the experiment throws but little and faint light.

If "agronomists" think that a knowledge of the elements of plant physiology is useful to the budding agriculturist, it would be best to let him follow a simple but systematic course in that subject, and not to restrict him to a few odds and ends of experiments which serve for little else than occasions for providing "morals"—conclusions which may or may not follow from the experiments and statistics which, though valuable enough in themselves, have no legitimate relation with the experiment to which they purport to refer. For example (Exercise 9), the child digs up 5 lb. of clover or corn, and, having determined that, when exposed to the sun, it loses a considerable part of its weight, is informed that a field of oats uses 522 lb. of water for each pound of dry matter produced.

We fear that this attempt to get the child "rich quick" is doomed to failure, and we do not believe that even the American child will make much of a success of his garden by studying Exercise 50, on "Planning the Home Garden," pp. 122-24, or even by purchasing the apparatus required for the exercise—to wit, a 50-ft. tape and some plain drawing-paper.

F. K.

Dairy Farming. By Prof. C. H. Eckles and Prof. G. F. Warren. Pp. xv + 309. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 5*s.* net.

As was to be expected, the chapters dealing with the breeds of cattle, their selection, improvement, management, feeding, etc., have been written by Prof. Eckles, and follow the lines of his own book on that subject. He has also contributed a chapter on the common ailments of cattle, and one on milk and its products. Prof. Warren's contribution deals with the why and wherefore of dairying and dairy farming, and a great deal of information is given on matters which are not, as a rule, gone into very exhaustively by the average teacher in this country. Nevertheless, such information is of the greatest possible benefit in developing the mind of the future farmer and giving him an outlook which will carry him above rule-of-thumb methods.

This book is intended for teaching purposes, and there are questions and problems at the end of each chapter, also a list of books in some cases which may be read with advantage.

The modern farmer will find much that will interest him in this book, particularly in view of the changing conditions in our country at the present time, and there seems to be every reason why the value of the dairy cow as an economical producer of human food should be strongly pointed out to those already engaged in farming, as well as to those who are prospective farmers.

It is, however, chiefly as an aid to the teacher that this book is to be strongly recommended, and whilst the examples refer to American conditions, it ought to be possible to get similar data for British farms and utilise the information to the same ends.

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